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ABSTRACT

Issues pertaining to the application of educational technology in higher education are considered. Educational technology has been applied successfully in reaching the geographically remote in several jurisdictions, including Canada, and it has been important in giving adults a second chance at a university education. Claims have been made that it also can reach the psychologically remote (i.e., the unmotivated). To increase accessibility to higher education, Canadian universities have offered to a limited extent courses via broadcast television or videotape. An alternative to off-campus centers and television courses for the geographically remote is the correspondence course. Other techniques include telephone networks and the audiotape cassette. Britain's Open University was the prototype for making university level work accessible to those who missed their first chance to attend. Views concerning the application of electronic programmed learning to reaching the unmotivated and potential dropouts are addressed. It is suggested that while there have been numerous demonstrations at various North American and European centers that the application of technology in higher education can be used to reach some of those who have been traditionally excluded. Serious questions remain about whether the quality of programs is improved by the application of technology, whether innovation of this type is possible except in a few centers, given the resistance by many conventional institutions. A bibliography is appended. (SW)

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TECHNOLOGY IN HIGHER EDUCATION - DOES IT REALLY IMPROVE ACCESSIBILITY AND QUALITY AND COST LESS IN THE LONG RUN?

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TECHNOLOGY IN HIGHER EDUCATION - DOES IT REALLY IMPROVE ACCESSIBILITY AND QUALITY AND COST LESS IN THE LONG RUN?

Abstract

Some of the issues surrounding the application of educational technology in higher education are discussed in this paper. First, the question of whether the application of such technology allows the participation of some of those who might otherwise have been excluded from higher education is addressed. Secondly, the controversy about the quality of technologically innovative versus traditional programmes is explored. This leads to a consideration of what the "costs" and trade-offs are in the application of educational technology in higher education. A final section of the paper explores the reactions of faculty members and of institutions of higher learning to technological innovation.

I. DOES THE APPLICATION OF TECHNOLOGY INCREASE ACCESSIBILITY IN HIGHER EDUCATION?

Educational technology has been applied successfully in reaching the geographically remote in several jurisdictions, including Canada. It has also been important in giving adults a "second chance" at a university education. Claims have also been made that it can reach the "psychologically remote" i.e. the unmotivated. In this section, several aspects of "accessibility" are considered.

1. Reaching the Geographically Remote

Canadian universities have traditionally solved the problem of reaching the geographically remote student by (a) establishing off-campus centres to which professors are sent to offer periodic courses; (b) using local persons to teach the courses; (c) teaching by mail - the conventional correspondence course; or (d) combining correspondence with local tutorials. These systems have also been favoured by other countries with populations in geographically remote areas, such as the Soviet Union (Kuznetsov, 1975).

How successful have these approaches been in increasing accessibility to higher education? There is no doubt that thousands of students who would not otherwise have travelled to the main campus of a university have been

able to take courses at off-campus centres in Canada. On the other hand, travel is long and expensive for student and instructor and the overall costs are "staggering" in the words of Morris (1973), describing the experiences of UNB (which has one off-campus centre 285 miles away from the main campus). Memorial has found it impossible, for these reasons, to establish centres in regions of very scattered population, such as the Laborador Coast, the South Coast of Newfoundland and much of the Northern Peninsula (Grimmett, 1975).

One alternative used to a limited extent by Canadian universities has been to offer courses via broadcast TV or videotape. Memorial, for example, reached 6,581 students with 19 TV courses over a four-year period as compared to 7,042 students with 139 "live" courses (Grimmett, 1975). On the other side of the country, UBC, through its "Knowledge Network" will offer Fine Arts this year as its first programme entirely available on TV. In more populated areas such as Southern Ontario, there has been small-scale experimentation by Waterloo (Niemi, 1974), Ryerson (Canadian Univ. & College, Apr. 1972, p. 27) and more recently, Wilfred Laurier. The potential of the technique, however, has been largely untapped.[1] Avoidance of the medium is related to (a) negative experiences with closed-circuit videotaped lectures in the 60s (Carpenter, 1973) and the knowlege that adult learners prefer regular classes or even correspondence to educational television (Waniewicz, 1976, p. 100); (b) the costs involved; and (c) faculty resistence and "fear of exposure" (See Creet's comments, 1979). Use of broadcast television in an area such as Southern Ontario also immediately raises jurisdictional questions (and still other questions, if the concept of the "challenge examination" is widely adopted).

The relative lack of use of broadcast TV and videotape in Canada stands in contrast to the successful projects in the U.S. which have been described extensively in the literature. These include the well-established TV College in Chicago, which is a system of seven community colleges (Weinstock, 1975a); the TAGER network in Texas which links Southern Methodist University with nine other institutions and 11 industries in the Dallas-Fort Worth region (Carpenter, 1973, pp. 6-7); and the extensive use of videotape by Colorado State University (Smith, 1976). However, there has been at least one project of this type in the U.S. which was a spectacular failure (see Weinstock, 1976, "Default of a Dream...or Whatever Happened to Florida Atlantic U?")

An alternative to off-campus centres and TV courses for the geographically

remote is the correspondence course. The major difficulty with this technique, however, is delayed feedback on assignments, which varies with the reliability of the mail system. Holmberg (1979), a European authority on "distance education", reports that students appear to profit from feedback when it is given within seven to ten days, but become dissatisfied when the delay is longer (p. 27). Drop-out rates are notoriously high in correspondence courses and the decision to drop out is correlated with feedback delay (Rekkedal, 1972, cited by Holmberg, 1979). The one-to-one telephone call used in combination with traditional written correspondence materials, however, allows some direct counselling and feedback. This approach has been used successfully by open universities in Britain, Canada and the U.S. As Daniel & Meech (1978) point out, speaking of Athabasca in Northern Alberta: "[d]riving several hours to a discussion group in the darkness of mid-winter at -40°C. is not attractive, even if it is possible." (p. 95) The telephone is eminently preferrable.

More sophisticated telephone networks have also been tried. The University of Wisconsin, for example, has a set of "telephone classrooms" in courthouses, libraries and hospitals. Students plug a portable unit with loudspeakers and microphone into their telephone to receive the lecture and can exchange observations with fellow students at other locations (Weinstock, 1975b). In Canada, the University of Quebec also has an audio-conference system which allows the linkage of seven centres (Short, 1974). Compared to cable television, a telephone network is more accessible to remote areas and is cheaper. However, an attempt to establish a much smaller system than Wisconsin's in Newfoundland failed because "the telephone companies were unable to make the system function to specification...it was never possible to ensure that the centres could hear each other...and this inhibited the students in the use of the equipment..." (Grimmett, 1975, p. 129)

There are favourable reports on the more limited use of the "loud-speaking telephone" in a classroom situation (Goldman, 1978). However, since the speaker cannot be identified, it is somewhat impersonal. Further, as students wish to speak in turn, an inhibiting "musical chairs" ensues and the tutor is often bombarded with questions (Williams et al., 1975).

The audiotape cassette is another way to reach the geographically remote which has been used in Canada. However, Memorial found the method unacceptable because the time lapse between the answers and questions sent

by students to tutors was too long (Grimmett, 1975, p. 129). Waterloo University in Ontario has been much more successful using this method (Leslie, 1978; 1979); it offers lectures and tutorials by audiotape cassette for 200 courses, and had 7000 enrolled students during the 1977-78 academic year, including 130 from B.C. and 49 from the N.W.T. Students have complained because it regularly takes three weeks for them to receive feedback on assignments; however, "students in their course evaluations rate the overall delivery system as very effective." (Leslie, 1979, p. 39). Comments Leslie, "...we have gone ahead with this rather simple and reasonably cheap approach...and in the course of 10 years we have grown to be the largest university-level correspondence program in Canada." (p. 41)

2. Reaching Adults ("Second Chance Learning")

Britain's Open University (OU), which opened in 1971, was the prototype for making university level work accessible to those who missed their first chance to attend (Perry, 1977, Tunstall, 1974). At that time only 8% of those in the university age group were entering full-time higher education (Scupham, 1975)[2] and part-time studies were virtually inaccessible for employed adults even if they lived near universities. By 1975, the OU had graduated 28,000, with 60,000 still studying (Perry, 1978b). It is sometimes castigated for not meeting the goal of being a "working class university" - manual laborers and women are underrepresented. Further, failure rates in mathematics and science for those who do not have the qualifications to enter other British universities raise questions about the "open admissions" policy (See Clark, 1974, pp. 3-5). In defence of the OU, if students are grouped by their father's occupations, 52% of those entering the OU in 1971 had fathers who were manual labourers, while this was true for only 29% entering conventional universities (as compared to 64% manual labourers in the working population according to the 1966 census - see table in McIntosh et al., 1977, p. 38). As for the percentage of women enrolled, it has increased from 26% in 1971 to 42% in 1975 (McIntosh et al., p. v). McIntosh and Woodley (1975) admit that the drop-out rates for blue-collar workers are higher than for other students in the OU. However, they suggest that the OU system may not be the best way to reach these people.

Other OU systems which direct university level work towards adults in Japan, Beirut, Germany, Kenya and Israel, have met with varying degrees of success (see articles in MacKenzie et al., 1975). Vanderheyden and Brunel

(1977) describe four systems which offer some university-level work to adults:the Television Polytechnic in Poland, TRU in Sweden, the University Without Walls in the U.S. and the Télé-université in Quebec. All of these institutions are tending away from university-level work and towards general adult education as they evolve, probably because upgrading is necessary for the adults whom they serve.[3]

3. Reaching the Unmotivated

High drop-out rates in traditional correspondence courses and OUs have been linked to the "loneliness of thelong-distance learner" - his isolation and consequent decline in motivation - and periodic educational television broadcasts have been singled out as a motivator for such students (Perry, 1978b, p. 7; McAnany, 1977). It is further argued that learning can be "better directed" when the student's attention has been captured by the electronic media.

Contradicting these arguments are studies which show that a large proportion of students are initially negatively disposed towards learning with the aid of electronic media (Dubin & Hedley, 1969; Weinstock, 1976; Bobren, 1960). These negative attitudes have been related to the impersonality of the media - Dagnon & Spuck (1977) speak of "Orwellian vision of an impersonal and callous machine bleeping out instructions to dehumanized students."

The response to the charge of impersonality has been the birth of several new movements (characterized as a minor "instructional revolution" - Bowles, 1978) which have demonstrated how electronic media may be used, paradoxically, to "personalize" and "individualize" instruction. One such movement is based on Postlethwait's audio-autotutorial method of teaching biology (1963; see also Miles, 1976); it integrates lecture, discussion and laboratory teaching. Another is the so-called "Keller Plan" or PSI (Personalized System of Instruction) which allows self-pacing by the student even in disciplines such as physics and philosophy (Keller, 1968) and provides individual attention to students via tutors. A third is the famous PLATO IV (acronym for Programmed Logic for Automated Teaching Operations), which is a method of computer-assisted instruction in the classroom. That these systems of personalized instruction evoke positive responses and better performance from students has been shown by several studies (e.g. Fisher & MacWhinney, 1976; Taveggia, 1977; Magidson, 1978).

There is some evidence, however, that learning via electronic media is more difficult for lower-ability students (e.g. Cormier, Grégoire & Pagé, 1976). Perry, of the British OU, coments; "I do not think that the distance learning pattern is suited to school-leavers at all"(1978b, p. 9). Other educators argue that such media are not suited for any students. Tyler (1977), for example, in an article entitled "What Technology Cannot Do", makes the point that one cannot "assume that education is simply presenting ideas to a group of students eager to grasp these ideas...learning is an active process on the part of the student." (p. 455) It is also emphasised by McAnany (1977) that "the motivation argument about TV for improved learning rests on an assumption that there will be continued quality of TV programming and that students will not become as bored with television as they may have with their regular teachers." (p. 131). This is an issue that will be discussed in the next section of the paper.

A more basic objection to electronic "programmed learning" is made by Travers (1973), who argues that we know nothing about the psychological effects of programmes which bring the student under "stimulus control" and allow him to make "empty decisions". Presumably this is more of a danger with children, where the programmes might lead them "to expect correct answers from authority" (Baker, 1973, p. 271). Farnes (1976), however, has criticized the British OU for exercising "greater control over students' learning than most conventional universities". A counterargument to this "dangers of the electronic media" theory is that, since the student can switch off the TV whenever he wishes, learning via TV will actually promote the opposite of the "passivity, uniformity and authoritarianism" which is often found in the conventional lecture situation (Carlson, 1974). Further, it may reduce the trauma of two social classes meeting face-to-face (in the case of those who prefer not to admit to anyone that they cannot read or write). And finally, televised education may enable clients to "avoid the legal and administrative red tape often facing those officially enrolled..." (p. 28)

II. DOES THE APPLICATION OF TECHNOLOGY IN HIGHER EDUCATION IMPROVE THE QUALITY OF PROGRAMMES?

How does one measure "quality" in a programme of higher education? Some indirect traditional measures are the reputation of the faculty, rate of acceptance of graduates into graduate studies, student performance on examinations, ease of entry of graduates into professional schools and the labour market, etc. Putting aside the question of whether these measures adequately reflect "quality", however, it would still be difficult to judge programme quality using these measures because there is not much data available. In answering the question of whether the quality of programmes is improved by the application of technology, then, the comments of experts in higher education must be relied upon. Their comments indicate that there are "quality" problems in some higher education programmes using electronic media. Further, there are few such programmes universally judged to be successful. On the other hand, we have little information on the quality of conventional programmes. Perhaps all that the application of technology does is reveal more clearly the weak points of traditional programmes.

1. The Claims of Open Universities about Programme Quality

Advocates of open universities claim that the quality of their programmes will be high because it is open to public scrutiny (Gayfer, 1972; Perry, 1978b). Britain's OU has emphasized that it demands the same standards of excellence as demanded by other universities in the U.K. (Lewis, 1974). In fact, a higher proportion of OU academics have research degrees than academics in other universities (Fergueson, 1975). Further, Perry (1978b) reports that 867 of 4,000 OU graduates who were sampled had been accepted in postgraduate programmes - which is as high a proportion as other universities. Says Perry: "[t]his is the best - and incontrovertible evidence that, in academic circles, the Open University degree has been recognized as equivalent to any other." (p. 8)

Not all OUs reach such levels of quality and some have even been singled out as deserving of academic contempt (MacKenzie et al., 1975, p. 26). The use of tutors with less than masters level qualifications as practised by many OUs (including Athabasca and the Télé-université) may also have implications for programme quality. The training of tutors in Waterloo's

extensive correspondence programmes has also been questioned (Reid, 1979).

2. Technology and Programme Quality in Conventional Universities

Specific applications of electronic technology have been used in North American and European universities for decades. For example, techniques using television allow students to view objects or events which are too small, too big, too fast or too slow to be seen otherwise. Videotapes of material such as psychiatric interviews or interviews with recognized experts in a discipline have been constructed for student use (Southern Regional Education Board, 1966). Conventional courses have also been offered to larger numbers of students at reduced cost via closed-circuit TV (Kiel & Spitzer, 1977). And television has been used to provide direct feedback to an instructor so that he may improve his delivery (Trotter, 1970; Kozma et al., 1978).

In spite of these demonstrations, however, and although there is much verbiage about the potential for improving the student's learning through the use of some technology, the accumulated evidence does not show that student performance is favourably influenced by the use of electronic media. For example, a vast literature which has compared performance of students taught with television to those taught in the conventional mode conclusively shows that, overall, there is "no significant difference" in achievement between the two groups (Barrington, 1965; Chu & Schramm, 1968; Jamison, Suppes & Wells, 1974; Dubin & Hedley, 1969). Researchers have protested that this is because television has been used primarily to duplicate "talking faces" and that the full potential of the medium has not been exploited (Kozma, Belle & Williams, 1978; Fisher, 1978; Niemi & Anderson, 1974).

Bates & Gallagher (1976) further argue that the researchers involved in comparing learning via new vs. traditional media have taken such great pains to remove all the special advantages of each medium compared, that it is not surprising that they find "no significant differences." In their words, "it is like cutting off two legs of a horse to see whether it can run faster than a man" (p. 36). Thus, in spite of all the research and all the commentary, the issue of whether the application of technology in higher education improves learning is still to be resolved. It is unlikely that it will be resolved in the near future, however, since, as Allen (1976) points out, interest in the evaluation of media has declined, and there is at present only "lip service" to this type of research. We will have to be satisfied with the conclusion of some researchers that the quality of instruction via the new media varies

just as quality of instruction from different teachers varies.

3. High Quality "Hardware" but Low Quality "Software"

At the crux of the quality issue is the fact that there is a tremendous gap between the sophistication of the "hardware"(or machinery used in audio-visual instruction, such as television equipment, computers, videodiscs and satellites) and the "software" (originally, computer programs, but now all instructional materials such as books, film, audio- and videotape, etc.) For example, we now have the capability to transmit educational programmes across the world via communications satellites. Polcyn (1973) describes some spectacular American experiments which have been done with satellites, including exchanges of information among various universities in the Pacific and between Brazil and Stanford. The Canadian/ American CTS satellite ("Hermes") has also been used to transmit continuing medical education to remote doctors in Newfoundland (Boehnker, 1979) and to share engineering courses between Stanford and Carelton (Bluck, 1979). Polcyn, however, is concerned that the software is often ignored or given low priority in these experiments. His sentiments are echoed by Mody (1978), who participated in the Indian Satellite Experiment (SITE) of 1975-6. She complained that while 2,050 person-years of effort were spent on hardware for that experiment, only 850 were spent on software: "it is a major miracle that there were four hours of programmes ready for transmission every day in SITE."(p. 120)

Another new invention called a videodisc can store books, stills, motion pictures, computer data, etc. It can store 360 books of 300 pages - the Encyclopedia Britannica with room to spare (Wood, 1979). Further, the information can be accessed in seconds, meaning that an educator could have "at his fingertips every still visual instructional material that he has ever seen available in his given curriculum area" (Smellie, 1979, p. 33). The invention, however, has as yet found few educational applications. "Teletext" (the Canadian system is "Telidon") is another technology which gives the TV viewer access to an immense information set (e.g. news, transportation schedules, movie listings, etc.) So far, its commercial use far outweighs its educational use. The micro-computer is another piece of hardware that will soon be available widely at low cost for which we have little educational software (Braun, 1977). Bowles(1978) comments that: "the low cost of microcomputer hardware will be of little value without

expensive software to make the hardware perform the complex tasks required in instructional applications." (p. 153)

One might argue that the criticism that satellites, videodiscs and videotext have not yet found important educational applications is unfair, since many technical inventions of the first half of the twentieth century have a gap of over 50 years between invention and application.[4] However, some familiar technological items which have been with us for 30 years or more, including broadcast and cable television[5] have failed to produce the revolution in post-secondary education which it was once expected they would produce. There are successful examples of "wired" campuses (Rumsby, 1978) and even interactive educational TV networks such as Q.U.B.E. in Ohio (Jordan, 1978). But in general, software development lags behind the rather sophisticated hardware. In the next section of the paper, some of the reasons underlying this inadequacy of instructional software are explored.

III. SOFTWARE COSTS - CAN THEY BE OFFSET IN THE LONG RUN BY INCREASED EFFICIENCY?

One reason for the "hardware-software" gap in educational technology has to do with the involvement of the private sector with the production and marketing of the hardware, which is not developed with educational applications in mind. Another is the high cost of software production, which because it is labour intensive, is difficult to circumvent. Some technologists argue that a serious effort to produce the software might be warranted if the costs could be recovered, although cost-benefit analyses are rare in the literature. If one examines what is to be done with any savings through the use of technology, however, it becomes clear that priorities have to be set on educational and other goals.

1. The High Cost of Instructional Software

Polcyn estimated, in 1973, that the average cost of production of an educational broadcast television programme was about $5000 per hour, although high-quality programmes such as "Sesame Street" could go as high as $50,000 per hour. A much cheaper way to produce instructional television programmes is to use videotape. While some conventional universities have shown cost-effectiveness and student satisfaction with

this "less than Academy Award winning instructional television" (Cory, 1973; Jamison & Lumsden, 1973; Porter, 1978), others are unwilling to make this trade-off between programme quality and cost and are now expressing bitter disillusionment about the costs (Popham, 1977).[6]

One way to avoid the compromise between quality and cost of software is to share it among institutions. However, this has sometimes "run afoul of existing copyright laws." (Wagner et al, 1969) Further, some British OU material has proven not to be culturally transferable to Canada and the U.S. Muir (1979), for example, had to terminate a British OU introductory psychology course at Regina in 1977. Students objected mainly because the British material contained some socio-cultural references which they did not understand, but there were also complaints about the heavy demands of the course. An experiment with British OU materials and techniques in three American universities (Houston, Maryland and Rutgers) in 1972 proved more successful, although there was some difficulty obtaining the material. Students also complained about the usage of British examples in the explanation of concepts and the British accent in the audiotapes (Hartnett et al., 1974, p. 64). More complaints came from full-time as opposed to part-time students in the experiment, which is consistent with Perry's (1978b) warning that British OU material may not be transferable for full-time students.

Exchange of PLATO material has had some success in the U.S. (e.g. see Hofstetter, 1976). The quality of the over 6,000 hours of instructional material in this system, however, has been questioned. Mitzel (1977, p. 457) says that there is an assumption:

> that a sizeable amount of high quality interactive material is available from the developmental efforts at the University of Illinois over the past few years. Nothing could be further from the truth. PLATO material ...treated CBE (Computer Based Education) as supplemental to other forms of education rather than as a replacement. The result is a lot of 'first effort' lessons which are only fragments of courses...

2. The Acquisition of Irrelevant and Costly Hardware

As difficulties in developing software emerge, the pressure from hardware marketers continues. Education was identified as a hardware "market" when the development of educational technology was heavily subsidized by the American government and by bodies such as the Ford Foundation in the 1950s and 60s. The hardware, however, was designed for defense, news and entertainment, with education

having to "accept what it could use as a spin-off from other activities." (MacKenzie et al., 1975) Thus, North American universities have spent a great deal of time "trying to fit courses to teaching equipment." (Potvin, 1975, p. 34) No less an authority than B.F. Skinner recommends that:

> [t]he most effective first step in developing a technology of teaching should be an analysis of the behaviour of the student, not an exploration of the uses of the hardware... (1977, p 456)

Too often, however, a technology has been chosen before its relevance to an educational problem has been established (McAnany, 1977).[7]

Will these trends continue? Hoban (1977), in a pessimistic article entitled "Educational Technology and Human Values", does not foresee any change. In the case of Canadian universities, Potvin (1975) advises that money would be better spent establishing written, telephone or personal contact with students than in electronic technologies. Creet(1979) reports that universities such as Ottawa and Western have in fact "transferred their priorities in part-time work to vigorous development of face-to-face teaching in off-campus locations."(p. 111) Other universities, such as Waterloo, Ryerson and Wilfrid Laurier, have opted for at least limited investment in electronic "distance education."

3. "Efficiency" versus Other Values

Assuming for a moment that the application of technology in higher education could produce cost-effectiveness, it might then be asked how the "savings" are actually to be made, and further, what is to be done with the savings. The answer to the first question is that, since higher education is a labour intensive activity, major improvements in efficiency will necessarily involve curtailment of numbers of faculty within institutions or of some of their activities. In answer to the question of what is to be done with the savings, there are several possibilities, including the following:

(a) the "saved" time of the faculty members could be ploughed back into the instructional process, allowing an improvement in programme quality or the reaching of more students;

(b) the "saved" time could be devoted to other important activities, such as research and PhD. instruction;

(c) the total "saved" time might release an absolute number of professors from the field of higher education to devote their time to some other societal endeavour.

These proposals, however, bring us face-to-face with some difficult questions, all of them involving the priorities set on various activities. For example, what if professors do not want to be released to another sector? What is more important - research or improving instructional quality? What is more important - education, or some other sector, such as defence or social services? And so on. As McAnany (1977) puts it, "...seeking greater efficiency is a value and can be chosen at the expense of other values." (p. 132) In an attempt to grapple with these priorities, Travers (1973) suggests that,

> the conservative in education seeks to develop the traditional skills at less cost to the taxpayer. The radical is not against improving the efficiencies... but...cannot be preoccupied with mere problems of cost ...for a change in society brought about by education may be of priceless value... (p. 988)

Returning to the original question of whether software costs could be retrieved, it is clear that it can only be answered when the priorities of the institution or the society are clear. Presumably, Travers would not be bothered even if the operation ran at a loss (i.e. resources were taken out of other sectors and put into education). In the final analysis, however, the argument is really academic, since institutions, in their tendency to perpetuate themselves through time (preferably with minor perturbations) will probably not debate such issues at length, or, if they do, will be unable to implement major changes in priorities. It is to this problem of resistence to innovation that we turn in the last section of the paper.

IV. THE APPLICATION OF EDUCATIONAL TECHNOLOGY IN HIGHER EDUCATION VS. MAINTAINING THE STATUS QUO

On the reasons that instructional technology has failed to live up to expectations in higher education, VanWyck (1976) comments that,

> [a]lthough some can legitimately claim that lack of financial resources and inadequate administrative and technical support have hampered efforts to innovate, the largest single factor affecting teacher adoption is teacher resistence. (p. 291)

MacKenzie et al. (1975) agree. They comment that "[r]ejection by the teaching force of educational innovations, especially those involving the use of 'educational technology', is the commonest cause of failure

of these schemes..." (p. 25) Flood Page (1971) compares the process of transplanting new technical aids into the educational body to organ-transplanation in the medical world: "the key question is not: 'Does the instrument work?' but 'Will the academic body accept or reject it?" (p. 32)

There is a growing literature on faculty resistence to innovation which documents the dynamics of such situations and makes recommendations on how to bring about change. Evans & Leppman's Resistence to Innovation in Higher Education (1968) and Dubin & Hedley's The Medium May Be Related to the Message (1969) were two early studies in this vein. The Evans & Leppman book is an analysis of an attempt to introduce television teaching into an institution which they called "Metro University". As Flood Page (1971) observes, it makes "gloomy reading for the dedicated audio-visual aids man." It documents widespread ignorance on the part of faculty members about technical innovations and about the services of their own audio-visual departments; budgets which support existing systems with allocation providing little flexibility for change; a pattern of "pseudo-acceptance" of an innovation on an experimental basis with subsequent abandonment; hostility to instructional television, which was labelled as a "toy"; and so on.

It is not difficult to understand why faculty members might resist technological innovation. The ultimate threat is that the faculty member himself may be replaced. Dubin & Hedley (1969), for example, comment that, "...educational television has the potential of displacing large numbers of teachers from teaching. Whether or not this is consciously recognized among professors, it is a self-evident conclusion." (p. 71). They argue that the "countermeasure" most often employed by the faculty member threatened with technological innovation is to insist "that the loss of student-faculty contact literally eliminates functional teaching"(p. 71). Often personal interaction is equated with programme quality (Evans & Leppman, 1968, p. 142).

Even if the ultimate threat of technological innovation is not exercised, however, the introduction of certain types of educational technology, including television, are threatening. This is because the innovations invade the area of the faculty member's control and "change, to some extent, the functions, necessary skills and responsibilities of the staff." (MacKenzie et al., 1975, p. 28) Flood Page agrees that "teachers

are prepared to try out new things...if they do not disturb the previous pattern of teaching, do not cost much money, are easy to handle, do a given job at least as well as whatever they replace, and are not likely to need a lot of maintenance and technical care." (1971, p. 33) Carpenter (1973), however, argues that it is difficult to justify the expense of a technological innovation which is "only an adjunct to the teacher's business as usual." If the innovation is to be more than an adjunct, "the teacher must take on the new roles of coordinator and manager and submerge the old role of primary purveyer of instruction." (p. 30) But this type of change requires a change in their concept of what the process of education should be (Wedemeyer, 1978) and that is difficult to achieve without sufficient incentive. Carpenter feels that there is a "lack of usable information on effective change" and that such information must be collected and examined if faculty resistence is to be overcome.

At the societal level, referring to the many failures of conventional universities to exploit the possibilities offered by new technology, Perry (1978b) notes that, in developed countries,

> there is an immense inertia in the traditional system so that the force required to produce any change must be immensely powerful. The inertia stems in part from the wholly justifiable belief that the traditional system has worked well for centuries and the consequent distrust of any proposed change; partly it stems from the vested interests in maintaining it for commercial reasons; and partly from the fear of redundancy on the part of those who work in it. (p. 5)

Britain's Open University, he contends, has generated so much interest because "it is one of the few instances where, in a developed country, a new pattern has been introduced on a large scale and has succeeded in co-existing with the traditional pattern..." (p. 5)

MacArthur's (1974) account of the beginnings of the British OU make clear its origin as part of the political platform of the Opposition Labour Party in the early 1960s. He outlines a number of obstacles which had to be overcome before the idea was actually implemented in 1971, leaving the impression that it was only by chance that it survived its incredible opposition. It is interesting that some of the political obstacles encountered by the British OU in "getting started" were also encountered in Canada during the establishment of Athabasca and the Télé-université (Daniel & Smith, 1979). Daniel & Smith support Perry's (1978b) contention

that institutional autonomy (rather than dependence upon a conventional university) is necessary for the proper functioning of an OU. MacKenzie et al.(1975) agree. They point out that existing institutions of higher education have been "unable or relunctant" to take on the role of "bringing new ways of teaching and learning to a new clientele." (p. 30) They go on to suggest that those who plan educational innovation should make it their business to "study the nature of change and the means by which it may be controlled." They add that the nature of the OU will vary with the type of political system, the freedom of the students, the sophistication of the communications system and relationships with conventional universities, and they call for more research on these variables.

V. SUMMARY

While there have been numerous demonstrations at various North American and European centres that the application of technology in higher education can be used to reach some of those who have been traditionally excluded, there remain serious questions about (a) whether the quality of programmes is improved by the application of technology; (b) whether the "costs" involved are justified; and (c) whether innovation of this type is possible except in a few centres, given the inertia of most conventional institutions of higher education.

Perhaps the area which is most promising for the application of technology in higher education is in correspondence courses or off-campus centres. However, the use of high-cost technology such as television, may not be justified for such use, and there have been problems with the use of television in higher education in Canada, the U.K. and the U.S. Another promising area is in the individualization of coursework with the use of multi-media supplements to traditional instruction. However, again, there is some doubt that such methods are appropriate for all students.

There is little hard evidence which would indicate that the use of electronic technology actually improves the quality of programmes, although the research which yields this result has been criticized. As well, there is the feeling that instructional media have not been used to their full potential. However, it is widely recognized that there are trade-offs between programme quality and the cost of producing the "software" for electronic media. Some American institutions have acquired expensive

"hardware" before the high cost of "software" was apparent. Others, which have demonstrated "savings" with the use of instructional technology, face the problem of framing new lists of priorities and perhaps changing the character of their institutions. These institutions are in the minority, however; most conventional universities in North America have only "tinkered" with the use of new instructional technology, tending to resist the major changes which a widespread adoption of instructional technology would involve. On the other hand, instructional technology appears to be coming into its own in a number of autonomous and semi-autonomous "open universities" which have come into existence all over the world. The implications of this new development in higher education are not yet fully apparent.

FOOTNOTES

1. Lewis (1977) reports that O.E.C.A. has grown from 170 programmes in 1965 to 1899 programmes and 5 stations in 1974-5. However, Creet (1979) found only 3 university courses utilizing O.E.C.A. in 1976-77. O.E.C.A. is the Ontario Educational Communications Authority.

2. This is not true in jurisdictions such as Ontario where "every student who could meet university entrance standards and who applied has been admitted to an Ontario university" (Trotter, 1970, p. 40). The situation in Ontario is more like that in Australia, which has a well-developed system of institutions of higher education (Braithwaite & Batt, 1975).

3. Canada has had historical involvement with general adult education via the media from the 1930s through to the cooperative cable movements of the 60s and 70s. A review of this material, however, and of the literature on open primary and secondary schools in several parts of the world (McAnany, 1977) is beyond the scope of this paper.

4. Scientific American (July, 1979, p. 29), in a review of the recently-issued Volumes VI and VII of A History of Technology edited by Trevor Williams, points out that one of these volumes contains a table of 46 inventions between 1900 and 1950, a number of which took 50 to 79 years to find application.

5. The number and locations of transmitters for broadcast television is restricted, since they must share the same airwaves. Even though broadcasters on the same frequency are usually 200 miles apart, cities are closer together than this, and adjacent channels often interfere. Physical obstructions also cause "shadow areas". High receiving antennas were thus set up to distribute TV signals in these areas via wires - and cable TV (CATV or Community Antenna TV) was born. Now any number of channels are available in a given area. Cable is so popular in Canada that the concept of the "wired city", through which everything from video to data resources can be made available in the home and industry, is not unrealistic (Jackson, 1972).

6. There is a small amount of literature which has attempted to show the cost-effectiveness of the British Open University as compared to conventional institutions (e.g. Wagner, 1977; Mace, 1978). The gist of the argument is

that the cost of producing a graduate at the OU, which takes advantage of economies of scale, is only one-third the cost of producing a graduate at a conventional university. By the same argument, it is difficult to demonstrate cost-effectiveness for open universities in most other jurisdictions, including Canada, because the fewer numbers of students involved would disallow economies of scale (e.g. see Clark, 1974).

7. Criticizing an article by Norris which advocates more technology for education, Thelen (1977) remarks, "And once again the bottom-line claim boils down to doing 'what the present educational process does' - but in a way profitable to the private sector." (p. 458)

APPENDIX

DESCRIPTION OF LITERATURE CONSULTED

The literature on educational technology in higher education that was consulted in the preparation of this discussion of issues falls into four broad categories. The first category includes academic literature produced by scholars in various disciplines on various topics: (a) the history of educational technology (Saettler, 1968; Hawkridge, 1976); (b) attempts to evaluate the quality of instruction using audio-visual aids as compared to conventional instruction (Fisher & MacWhinney, 1976; Barrington, 1965); (c) analysis of the responses of individuals or institutions to adoption of educational technology (Stecklein & Olson, 1961; Evans & Leppman, 1978); (d) the application of educational technology and techniques in specific courses (Postlethwait, 1963; Journal of Personalized Instruction); and (e) discussion about difficulties and advantages of particular techniques (Short, 1974; Haeffner, 1975).

A parallel body of literature focusses specifically on the application of educational technology to what is variously termed adult education, continuing education, open learning or non-traditional study. In this paper, it is assumed that "conventional" and "open" higher education are points on the same continuum. Literature on "distance learning", "correspondence" and "open universities" is included (Adler & Baer, 1973; Holmberg's biblicgraphy, 1977; Perry, 1977; Canadian Journal of University Continuing Education; MacKenzie et al., 1975; Daniel & Umbriaco, 1974). Literature which deals with primary or secondary education or with community-based adult education, including that on public television, is also relevant but is so large as to be beyond the scope of this paper. The line has arbitrarily been drawn at what is clearly "higher education."

In contrast to the academic literature are numerous American publications which report on the latest hardware that has been developed and how it has been applied in higher education across the country. Some of this literature is produced by educational institutions themselves (TV and Higher Education), but much of it, complete with rather slick, glossy-paged advertisements, is the work of those who market the hardware (Industrial and Educational TV).

Somewhere between the scholarly work and the gloss falls material produced by or for governments (Canada Department of Manpower & Immigration, 1974; Trotter, 1970); by public and private groups such as the Ford Foundation (Armsey & Dahl, 1973), the Carnegie Commission (The Fourth Revolution, 1972) and the Rand Corporation (Carpenter, 1973); and international agencies such as USAID and UNESCO (Groombridge, 1966). This is part of a broader literature which describes the technology itself without focussing on the particular applications which might be made in education or which documents the national and international consequences of the development of various communications technologies (e.g. Clyne Report, 1979).

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